



# REFORMED CHURCH UNIVERSITY

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## FACULTY OF EDUCATION AND SOCIAL SCIENCES

BACHELOR OF SCIENCE HONOURS DEGREE IN INFORMATION  
TECHNOLOGY

Artificial Intelligence

**HICT 403**

**Part 1 Semester 1 Examination**

**Total Marks [100]**

Date: July 2022

Time: 3 Hours

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### INSTRUCTIONS

1. This paper has *six (6)* questions
2. Answer any *four (4)* questions
3. Each question carries *25 marks*
4. Start each question on a new page

## QUESTION 1

(a) Discuss the core components that drive most Artificial Intelligence (AI)/ Machine Learning applications. (20)

(b) Consider the following clausal form:

isa (X, living\_thing); isa(X, animate)

isa(X; animate); isa(X, human)

isa(X, human); isa(X, man)

isa(Jay, man)

Represent forward reasoning inference (5)

## QUESTION 2

(a) Discuss the expert system in the domain of medicine using a suitable case study and explain its architecture, describing its contents. (15)

(b) Explain the differences between:

(i) Deductive and Inductive reasoning (5)

(ii) Forward and Backward reasoning (chaining) (5)

## QUESTION 3

(a) Three missionaries and three cannibals wish to cross the river. They have a small boat that will carry up to two people. Everyone can navigate the boat. If at any time the Cannibals outnumber the Missionaries on either bank of the river, they will eat the Missionaries.

(i) In the context of the above case, explain the following terms; Goal state, initial state, operators, constraint. (8)

(ii) Find the smallest number of crossings that will allow everyone to cross the river safely. (12)

(b) Write short notes on the following

- (i) The significance of sensors and vision system in robotics designing (3)
- (ii) Knowledge representation in Artificial Intelligence (2)

#### **QUESTION 4**

(a) Consider the following sentences. For each of them, explain if it can be written out in first order logic. If your answer is yes, give the corresponding logical statement. If the answer is no, explain the difficulty.

- (i) All the existing kinds of birds can fly (5)
- (ii) Some existing kinds of birds can fly (5)
- (iii) At least two existing kinds of birds can fly (5)
- (iv) Most existing kinds of birds can fly (5)

(b) Explain the following

- (i) Validity of a statement (2)
- (ii) Satisfiability of a statement (3)

#### **QUESTION 5**

Consider the following Knowledge Base:

Rule 1: If A and B Then D

Rule 2: If A and E Then C

Rule 3: If C and not (D) Then E

Rule 4: If B and D then G

Rule 5: If C and I Then H

Rule 6: If G and not (H) Then I

Rule 7: If not(C) Then B

Rule 8: If G and I Then K

Rule 9: If not (H) and I Then L

(a) Given these facts in working memory initially: **A**

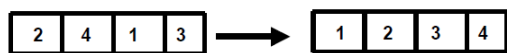
List the different facts deduced by the inference engine when using **forward chaining** (data driven reasoning). For conflict resolution, use rule order as implied priority (if there is a conflict, choose the rule with smallest number). For the case of fact with negation, use closed world assumption: if the fact is present in WM (working Memory) then it is true (its negation is false) otherwise it is false (its negation is true). [13 Marks]

(b) Given the facts in working memory initially: **A**

Is the goal **K** true or false? Justify using **backward chaining** (Goal driven reasoning). For conflict resolution, use rule order as implied priority (if there is a conflict, choose the rule with smallest number). For the case of fact with negation, use closed world assumption: if the fact is present in WM (working Memory) then it is true (its negation is false) otherwise it is false (its negation is true). [12 Marks]

## QUESTION 6

Consider the problem of sorting numbers into ascending order:



- **State representation:** a sequence of four numbers

- **Initial state:** 2, 4, 1, 3

- **Goal state:** 1, 2, 3, 4.

- **Operators:**

- **Swopleft:** swaps leftmost numbers e.g., in the initial state, 2 and 4.

- Swapmiddle: swaps numbers in the middle e.g., in the initial state, 4 and 1.
- Swapright: swaps rightmost numbers e.g., in the initial state, 1 and 3.

Operators should be applied in this order: Swapleft, Swapmiddle, then Swapright.

- **Path cost:** number of swaps.

Solve this problem using IDS - a blind search technique (Iterative Deepening Search). To cope with repeated states, do not add a state as a leaf if that state is on the path from the root to the current node of the generated tree. (25)